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## TONER CARTRIDGE IDENTIFICATION SYSTEM FOR A PRINTER

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates generally to toner cartridge consuming products such as printers, and more particularly to an apparatus and method for identifying a printer's toner cartridge using a series of magnetic couplings to generate a cartridge specific identification code.

#### 2. Description of Related Art

The use of toner in paper processing machines to transfer text or images onto stock paper is now commonplace. In many cases toner is delivered via a cartridge specifically designed for the particular machine. Toner cartridges are used in copying machines, stand alone printers, facsimile machines, and a wide assortment of machines designed to process stock or blank paper into paper with print, images, text, or graphics. The methodology behind the particular printing technology is not necessary for an understanding of the present invention and will be omitted for simplicity.

The manufacture of toner using equipment are concerned about the use of the equipment after its initial sale because the manufacture is typically obligated to repair the equipment under warranty agreements. If the equipment can be used improperly, it is often the manufacture who bears the burden of increased costs associated with the misuse of the equipment. One of the main issues that confront these manufacturers is the use of toner cartridges that are not specifically designed for the particular application. The use of some toner cartridges will damage the equipment and cause undo wear and other difficulties.

The problem persists because most varieties of toner cartridge use an interchangeable cartridge design. Many printers include settings optimized for a specific toner cartridge brand or type based on specifications, testing, or experience of the cartridge's manufacture. The use of interchangeable cartridges leads to the printer's misinterpretation of the contents of the cartridge, with corresponding misapplied settings specifically adapted for a special cartridge's characteristics. The result is a poor quality print product and potential damage to the printer. This results in significant costs to the party responsible for maintenance, which must continually repair the toner consuming machines due to the use of non-approved toner, and must answer to questions of poor printer quality.

### SUMMARY OF THE INVENTION

The present invention is a method and apparatus for identifying a type of printer cartridge to the printer, where magnetic elements on the cartridge and the printer combine to form a magnetic coupling that generates a cartridge specific code to identify the toner cartridge as being of a predetermined type. In a preferred embodiment, the magnetic coupling is achieved using one or more reed switches preferably mounted on the printer (although the switches could be mounted on the cartridge with similar results), with the reed switches biased using fixed magnetic elements placed immediately adjacent the reed switches. In the absence of any further magnetic fields, the reed switches are selected to provide a known set of switch positions corresponding to a bit value of one ("1") for an open circuit and a bit value of zero ("0") for a closed circuit. Magnetic elements on a printer cartridge are positioned to be disposed

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adjacent the reed switches and opposite the fixed magnets, and of a size and field strength sufficient to counteract the fixed magnetic elements adjacent the reed switches when the cartridge is inserted into the printer. By detecting the status of the reed switches on the printer as "open" or "closed," a sequence of bits of "1"s and "0"s can be achieved. This data can be used to distinguish one printer cartridge from another and allow automatic optimization of the printer settings based on the cartridge recognition.

### BRIEF DESCRIPTION OF THE DRAWINGS

The exact nature of this invention, as well as its objects and advantages, will become readily apparent upon reference to the following detailed description when considered in conjunction with the accompanying drawings, in which like reference numerals designate like parts throughout the figures thereof, and wherein:

FIG. 1 is a schematic diagram of a reed switch in a normally closed ("NC") position;

FIG. 2 is a schematic diagram of a reed switch in the presence of an applied magnetic field to provide a normally open ("NO") position;

FIG. 3 is a schematic diagram of a reed switch in the presence of equally opposed magnetic fields, returning the switch to its normally closed position;

FIG. 4 is an elevated perspective view of a preferred embodiment of a cartridge and printer magnetic elements of the present invention; and

FIG. 5 is a perspective view of a pair of magnetic elements for use with a cartridge of the present invention.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description is provided to enable any person skilled in the art to make and use the invention and sets forth the best modes contemplated by the inventor of carrying out his invention. Various modifications, however, will remain readily apparent to those skilled in the art, since the general principles of the present invention have been defined herein specifically to provide a method and apparatus for identifying a printer cartridge by a printer using a non-volatile magnetic code.

In the present invention, the printer must be able to recognize a particular toner cartridge by reading a sequence of magnetic field detecting switches. The preferred embodiment for accomplishing this object is to use a plurality of reed switches such as the one shown in FIG. 1.

A reed switch 10 is a device that is often times used as a proximity sensor to detect the presence of a magnet. A reed switch is usually a mechanical contacting switch, where the mechanical contact is typically enclosed in a tube structure 12. Internal to the reed switch are two ferromagnetic contacts, a normally open contact ("NO") 14 and a normally closed contact ("NC") 16. The normally open contact 14 is grounded, while the normally closed lead 16 is connected to an external power source supplying the appropriate voltage required by the equipment.

The reed switch as shown in FIG. 1 occupies a normally closed position in the absence of an external magnetic field. FIGS. 2 illustrates the situation where a magnetic element 18 is brought in proximity with the reed switch 10. In this case, the switch position will switch from the normally closed position to the normally open position as the reed is magnetically attracted to the externally applied magnetic field. The present invention preferably applies an initial magnetic